

What is claimed is:

1. An isolated nucleic acid encoding an insect gustatory receptor protein, wherein the receptor protein comprises seven transmembrane domains and a C-terminal domain, and the C-terminal domain comprises consecutive amino acids having the following sequence:

-G-L/F-F-X-X-X-X-X-X-X-X-X-X-T-Y-L-V/I-L-V/I/L-Q-F- (SEQ ID NO: 60),

where X is any amino acid, and / means or.

2. An isolated nucleic acid encoding an insect odorant receptor protein, wherein the receptor protein comprises seven transmembrane domains and a C-terminal domain, and the C-terminal domain comprises consecutive amino acids having the following sequence:

-G-L/F-F-X-X-X-X-X-X-X-X-X-X-T-Y-L-V/I-L-V/I/L-Q-F- (SEQ ID NO: 60),

where X is any amino acid, and / means or.

3. An isolated nucleic acid encoding an insect gustatory receptor protein, wherein the nucleic acid molecule encodes a protein selected from the group consisting of:

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(a) an insect receptor protein comprising consecutive amino acids having a sequence identical to that set forth for Gr2B1 in SEQ ID NO: 1,

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(b) an insect receptor protein comprising consecutive amino acids having a sequence identical to that set forth for Gr8D1 in SEQ ID NO: 2,

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(c) an insect receptor protein comprising consecutive amino acids having a sequence identical to that set forth for Gr10B1 in SEQ ID NO: 3,

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(d) an insect receptor protein comprising consecutive amino acids having a sequence identical to that set forth for Gr10B2 in SEQ ID NO: 4,

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(e) an insect receptor protein comprising consecutive amino acids having a sequence identical to that set forth for Gr28A2 in SEQ ID NO: 5,

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(f) an insect receptor protein comprising consecutive amino acids having a sequence identical to that set forth for Gr28A4 in SEQ ID NO: 6,

5 (g) an insect receptor protein comprising consecutive amino acids having a sequence identical to that set forth for Gr33C1 in SEQ ID NO: 7,

10 (h) an insect receptor protein comprising consecutive amino acids having a sequence identical to that set forth for Gr36B2 in SEQ ID NO: 8,

15 (i) an insect receptor protein comprising consecutive amino acids having a sequence identical to that set forth for Gr36B3 in SEQ ID NO: 9,

20 (j) an insect receptor protein comprising consecutive amino acids having a sequence identical to that set forth for Gr59C1 in SEQ ID NO: 10,

25 (k) an insect receptor protein comprising consecutive amino acids having a sequence identical to that set forth for Gr61D1 in SEQ ID NO: 11,

30 (l) an insect receptor protein comprising consecutive amino acids having a sequence identical to that set forth for Gr63F1 in SEQ ID NO: 12,

(m) an insect receptor protein comprising consecutive amino acids having a sequence

identical to that set forth for Gr64A2 in SEQ ID NO: 13,

5 (n) an insect receptor protein comprising consecutive amino acids having a sequence identical to that set forth for GR64A3 in SEQ ID NO: 14,

10 (o) an insect receptor protein comprising consecutive amino acids having a sequence identical to that set forth for Gr66C1 in SEQ ID NO: 15,

15 (p) an insect receptor protein comprising consecutive amino acids having a sequence identical to that set forth for Gr92D1 in SEQ ID NO: 16,

20 (q) an insect receptor protein comprising consecutive amino acids having a sequence identical to that set forth for Gr98A1 in SEQ ID NO: 17,

25 (r) an insect receptor protein comprising consecutive amino acids having a sequence identical to that set forth for Gr98A2 in SEQ ID NO: 18,

30 (s) an insect receptor protein comprising consecutive amino acids having a sequence identical to that set forth for Gr2940.1 in SEQ ID NO: 19,

(t) an insect receptor protein comprising consecutive amino acids having a sequence identical to that set forth for Gr2940.2 in SEQ ID NO: 20,

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(u) an insect receptor protein comprising consecutive amino acids having a sequence identical to that set forth for Gr2940.3 in SEQ ID NO: 21,

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(v) an insect receptor protein comprising consecutive amino acids having a sequence identical to that set forth for Gr2940.4 in SEQ ID NO: 22,

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(w) an insect receptor protein comprising consecutive amino acids having a sequence identical to that set forth for Gr2940.5 in SEQ ID NO: 23,

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(x) an insect receptor protein comprising consecutive amino acids having a sequence identical to that set forth for Gr57B1 in SEQ ID NO: 46,

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(y) an insect receptor protein comprising consecutive amino acids having a sequence identical to that set forth for Gr93F1 in SEQ ID NO: 48,

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(z) an insect receptor protein comprising consecutive amino acids having a sequence

identical to that set forth for Gr93F2 in SEQ ID NO: 49,

5 (aa) an insect receptor protein comprising consecutive amino acids having a sequence identical to that set forth for Gr93F3 in SEQ ID NO: 50,

10 (bb) an insect receptor protein comprising consecutive amino acids having a sequence identical to that set forth for Gr93F4 in SEQ ID NO: 51,

15 (cc) an insect receptor protein comprising consecutive amino acids having a sequence identical to that set forth for Gr94E1 in SEQ ID NO: 52,

20 (dd) an insect receptor protein comprising consecutive amino acids having a sequence identical to that set forth for Gr93D1 in SEQ ID NO: 53,

25 (ee) an insect receptor protein comprising consecutive amino acids having a sequence identical to that set forth for GrLU1=Gr36B1 in SEQ ID NO: 55,

30 (ff) an insect receptor protein comprising consecutive amino acids having a sequence identical to that set forth for GrLU2=Gr28A3 in SEQ ID NO: 56,

(gg) an insect receptor protein comprising consecutive amino acids having a sequence identical to that set forth for GrLU3=Gr64A1 in SEQ ID NO: 57,

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(hh) an insect receptor protein comprising consecutive amino acids having a sequence identical to that set forth for GrLU7=Gr5A1 in SEQ ID NO: 59, and

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(ii) an insect gustatory receptor protein which shares from 7-50% amino acid identity with any one of the proteins of (a)-(hh), and comprises seven transmembrane domains and a C-terminal domain, wherein the C-terminal domain comprises consecutive amino acids having the following sequence:

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-G-L/F-F-X-X-X-X-X-X-X-X-X-X-T-Y-L-V/I-
L-V/I/L-Q-F- (SEQ ID NO: 60),

where X is any amino acid, and / means or.

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4. An isolated nucleic acid molecule encoding an insect odorant receptor protein, wherein the nucleic acid molecule encodes a protein selected from the group consisting of:

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(a) an insect receptor protein comprising consecutive amino acids having a sequence identical to that set forth for Gr2B1 in SEQ ID NO: 1,

(b) an insect receptor protein comprising consecutive amino acids having a sequence identical to that set forth for Gr8D1 in SEQ ID NO: 2,

5 (c) an insect receptor protein comprising consecutive amino acids having a sequence identical to that set forth for Gr10B1 in SEQ ID NO: 3,

10 (d) an insect receptor protein comprising consecutive amino acids having a sequence identical to that set forth for Gr10B2 in SEQ ID NO: 4,

15 (e) an insect receptor protein comprising consecutive amino acids having a sequence identical to that set forth for Gr28A2 in SEQ ID NO: 5,

20 (f) an insect receptor protein comprising consecutive amino acids having a sequence identical to that set forth for Gr28A4 in SEQ ID NO: 6,

25 (g) an insect receptor protein comprising consecutive amino acids having a sequence identical to that set forth for Gr33C1 in SEQ ID NO: 7,

30 (h) an insect receptor protein comprising consecutive amino acids having a sequence identical to that set forth for Gr36B2 in SEQ ID NO: 8,

identical to that set forth for Gr66C1 in SEQ ID NO: 15,

5 (p) an insect receptor protein comprising consecutive amino acids having a sequence identical to that set forth for Gr92D1 in SEQ ID NO: 16,

10 (q) an insect receptor protein comprising consecutive amino acids having a sequence identical to that set forth for Gr98A1 in SEQ ID NO: 17,

15 (r) an insect receptor protein comprising consecutive amino acids having a sequence identical to that set forth for Gr98A2 in SEQ ID NO: 18,

20 (s) an insect receptor protein comprising consecutive amino acids having a sequence identical to that set forth for Gr2940.1 in SEQ ID NO: 19,

25 (t) an insect receptor protein comprising consecutive amino acids having a sequence identical to that set forth for Gr2940.2 in SEQ ID NO: 20,

30 (u) an insect receptor protein comprising consecutive amino acids having a sequence identical to that set forth for Gr2940.3 in SEQ ID NO: 21,

(v) an insect receptor protein comprising consecutive amino acids having a sequence identical to that set forth for Gr2940.4 in SEQ ID NO: 22,

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(w) an insect receptor protein comprising consecutive amino acids having a sequence identical to that set forth for Gr2940.5 in SEQ ID NO: 23,

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(x) an insect receptor protein comprising consecutive amino acids having a sequence identical to that set forth for Gr57B1 in SEQ ID NO: 46,

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(y) an insect receptor protein comprising consecutive amino acids having a sequence identical to that set forth for Gr93F1 in SEQ ID NO: 48,

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(z) an insect receptor protein comprising consecutive amino acids having a sequence identical to that set forth for Gr93F2 in SEQ ID NO: 49,

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(aa) an insect receptor protein comprising consecutive amino acids having a sequence identical to that set forth for Gr93F3 in SEQ ID NO: 50,

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(bb) an insect receptor protein comprising consecutive amino acids having a sequence

identical to that set forth for Gr93F4 in SEQ ID NO: 51,

5 (cc) an insect receptor protein comprising consecutive amino acids having a sequence identical to that set forth for Gr94E1 in SEQ ID NO: 52,

10 (dd) an insect receptor protein comprising consecutive amino acids having a sequence identical to that set forth for Gr93D1 in SEQ ID NO: 53,

15 (ee) an insect receptor protein comprising consecutive amino acids having a sequence identical to that set forth for GrLU1=Gr36B1 in SEQ ID NO: 55,

20 (ff) an insect receptor protein comprising consecutive amino acids having a sequence identical to that set forth for GrLU2=Gr28A3 in SEQ ID NO: 56,

25 (gg) an insect receptor protein comprising consecutive amino acids having a sequence identical to that set forth for GrLU3=Gr64A1 in SEQ ID NO: 57,

30 (hh) an insect receptor protein comprising consecutive amino acids having a sequence identical to that set forth for GrLU7=Gr5A1 in SEQ ID NO: 59, and

(ii) an insect odorant receptor protein which shares from 7-50% amino acid identity with any one of the proteins of (a), and comprises seven transmembrane domains and a C-terminal domain, wherein the C-terminal domain comprises consecutive amino acids having the following sequence:

-G-L/F-F-X-X-X-X-X-X-X-X-X-T-Y-L-V/I-L-V/I/L-Q-F- (SEQ ID NO: 60),

where X is any amino acid, and / means or.

15 5. The isolated nucleic acid of claim 1, 2, 3, or 4, wherein the nucleic acid is DNA or RNA.

20 6. The isolated nucleic acid of claim 6, wherein the DNA is cDNA, genomic DNA, or synthetic DNA.

7. The isolated nucleic acid of claim 1, 2, 3, or 4, wherein the nucleic acid is a Drosophila receptor.

25 8. A nucleic acid comprising at least 12 nucleotides which specifically hybridizes with the isolated nucleic acid of claim 1, 2, 3, or 4.

30 9. The nucleic acid of claim 8, wherein the nucleic acid is DNA, cDNA, genomic DNA, synthetic DNA, RNA or synthetic RNA.

10. A vector which comprises the isolated nucleic acid of claims 1, 2, 3, or 4.

11. The vector of claim 10, wherein the isolated nucleic acid is operatively linked to a regulatory element.

5 12. The vector of claim 11, wherein the vector is a plasmid.

10 13. A host vector system for production of a polypeptide having the biological activity of an insect gustatory receptor, which comprises the vector of claim 10 and a suitable host.

15 14. A host vector system for production of a polypeptide having the biological activity of an insect odorant receptor, which comprises the vector of claim 10 and a suitable host.

20 15. The host vector system of claim 13 or 14, wherein the suitable host is a bacterial cell, a yeast cell, an insect cell, or an animal cell.

25 16. A method of producing a polypeptide having the biological activity of an insect gustatory receptor which comprising growing the host vector system of claim 13 under conditions permitting production of the polypeptide and recovering the polypeptide so produced.

30 17. A method of producing a polypeptide having the biological activity of an insect odorant receptor which comprising growing the host vector system of claim 14 under conditions permitting production of

the polypeptide and recovering the polypeptide so produced.

18. A purified insect gustatory receptor protein encoded by the isolated nucleic acid of claim 1 or 3.
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19. A purified insect odorant receptor protein encoded by the isolated nucleic acid of claim 2 or 4.
- 10 20. An antibody which specifically binds to an insect receptor protein encoded by the isolated nucleic acid of claim 1, 2, 3, or 4.
- 15 21. An antibody which competitively inhibits the binding of the antibody of claim 20.
22. The antibody of claim 20 or 21, wherein the antibody is a monoclonal antibody.
- 20 23. A method of transforming a cell which comprises transfecting a host cell with the vector of claim 10.
24. A transformed cell produced by the method of claim 23.
- 25 25. The transformed cell of claim 24, wherein prior to being transfected with the vector the host cell does not express a gustatory receptor protein.
- 30 26. The transformed cell of claim 24, wherein prior to being transfected with the vector the host cell does not express an odorant receptor protein.

27. A method of identifying a compound which specifically binds to an insect gustatory receptor which comprises contacting the transformed cell of claim 24, or a membrane fraction from said cells, with the compound under conditions permitting binding of the compound to the gustatory receptor, detecting the presence of any such compound specifically bound to the receptor, and thereby identifying the compound as a compound which specifically binds to an insect gustatory receptor.

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28. A method of identifying a compound which specifically binds to an insect odorant receptor which comprises contacting the transformed cell of claim 24, or a membrane fraction from said cells, with the compound under conditions permitting binding of the compound to the odorant receptor, detecting the presence of any such compound specifically bound to the receptor, and thereby identifying the compound as a compound which specifically binds to an insect odorant receptor.

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29. A method of identifying a compound which specifically binds to an insect gustatory receptor which comprises contacting the purified insect gustatory receptor protein of claim 18 with the compound under conditions permitting binding of the compound to the purified gustatory receptor protein, detecting the presence of any such compound specifically bound to the receptor, and thereby identifying the compound as a compound which specifically binds to an insect gustatory receptor.

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30. A method of identifying a compound which specifically binds to an insect odorant receptor which comprises contacting the purified insect odorant receptor protein of claim 19 with the compound under conditions permitting binding of the compound to the purified odorant receptor protein, detecting the presence of any such compound specifically bound to the receptor, and thereby identifying the compound as a compound which specifically binds to an insect odorant receptor.

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31. The method of claim 29 or 30, wherein the purified insect receptor protein is embedded in a lipid bilayer.

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32. A method of identifying a compound which activates an insect gustatory receptor which comprises contacting the transformed cell of claim 24, or a membrane fraction from said cells, with the compound under conditions permitting activation of the gustatory receptor, detecting activation of the receptor, and thereby identifying the compound as a compound which activates an insect gustatory receptor.

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33. A method of identifying a compound which activates an insect odorant receptor which comprises contacting the transformed cell of claim 24, or a membrane fraction from said cells, with the compound under conditions permitting activation of the odorant receptor, detecting activation of the receptor, and thereby identifying the compound as a compound which activates an insect odorant receptor.

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34. A method of identifying a compound which activates an insect gustatory receptor which comprises contacting the purified insect gustatory receptor protein of claim 18 with the compound under conditions permitting activation of the gustatory receptor, detecting activation of the receptor, and thereby identify the compound as a compound which activates an insect gustatory receptor.

10 35. A method of identifying a compound which activates an insect odorant receptor which comprises contacting the purified insect odorant receptor protein of claim 19 with the compound under conditions permitting activation of the odorant receptor, detecting activation of the receptor, and thereby identify the compound as a compound which activates an insect odorant receptor.

15 36. The method of claim 34 or 35, wherein the purified insect receptor protein is embedded in a lipid bilayer.

20 37. A method of identifying a compound which inhibits the activity of an insect gustatory receptor which comprises contacting the transformed cell of claim 24, or a membrane fraction from said cells, with the compound under conditions permitting inhibition of the activity of the gustatory receptor, detecting inhibition of the activity of the receptor, and thereby identifying the compound as a compound which inhibits the activity of an insect gustatory receptor.

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38. A method of identifying a compound which inhibits the activity of an insect odorant receptor which comprises contacting the transformed cell of claim 24, or a membrane fraction from said cells, with the compound under conditions permitting inhibition of the activity of the odorant receptor, detecting inhibition of the activity of the receptor, and thereby identifying the compound as a compound which inhibits the activity of an insect odorant receptor.

39. A method of identifying a compound which inhibits the activity of an insect gustatory receptor which comprises contacting the purified insect gustatory receptor protein of claim 18 with the compound under conditions permitting inhibition of the activity of the gustatory receptor, detecting inhibition of the activity of the receptor, and thereby identifying the compound as a compound which inhibits the activity of an insect gustatory receptor.

40. A method of identifying a compound which inhibits the activity of an insect odorant receptor which comprises contacting the purified insect odorant receptor protein of claim 19 with the compound under conditions permitting inhibition of the activity of the odorant receptor, detecting inhibition of the activity of the receptor, and thereby identifying the compound as a compound which inhibits the activity of an insect odorant receptor.

41. The method of claim 39 or 40, wherein the purified insect receptor protein is embedded in a lipid bilayer.

42. The method of any one of claims 27-30, 32-35, or 37-40, wherein the compound is not previously known.

5 43. A compound identified by the method of claim 42.

44. The compound of claim 43, wherein the compound is an alarm odorant ligand.

10 45. The compound of claim 43, wherein the compound is a ligand associated with fertility.

46. The compound of claim 43, wherein the compound the compound interferes with chemosensory perception.

15 47. A method of combating ingestion of crops by pest insects which comprises identifying a compound by the method of any one of claims 27-30, 32-35, or 37-40, and spraying the crops with the compound.

20 48. A method of combating disease-carrying insects in an area which comprises identifying a compound by the method of any one of claims 27-30, 32-35, or 37-40, and spraying the area with the compound.

25 49. A method of controlling a pest population in an area which comprises identifying a compound by the method of any one of claims 27-30, 32-35, or 37-40, and spraying the area with the compound.

30 50. The method of claim 49, wherein the compound is an alarm odorant ligand.

51. The method of claim 49, wherein the compound is a ligand associated with fertility.
52. The method of claim 49, wherein the compound
5 interferes with chemosensory perception.
53. A composition which comprises a compound identified
10 by the method of any one of claims 27-30, 32-35, or
37-40, and a carrier.
54. A method of preparing a composition which comprises
15 identifying a compound by the method of any one of
claims 27-30, 32-35, or 37-40, recovering the
compound free from the receptor, and admixing a
carrier.
55. A method of controlling a pest population in an area
20 which comprises identifying a compound by the method
of claim 27, and spraying the area with the compound.
56. The method of claim 55, wherein the compound is a
ligand associated with fertility.